Space Weather Technical Forecast

Issued on Sunday, 23 July 2023 at 13:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares and R1/R2 blackouts throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, although a C9.9 flare was observed from AR3373 at 23/0454 UTC. There are currently 8 regions on the Earth facing disc, with a new region currently appearing round the southeast limb. This is presently classed as Hsx/Alpha but is likely to reveal more complexity as it comes further into view. AR3373, in the northwest, is the largest and most complex region on the disc, although it has decayed slightly with the loss of some of its intermediary spots. AR3372 and AR3379, on opposing sides of the solar disc, are of similar magnitude, but are less complex. AR3372 remains unchanged, but AR3379 has had some decay, with the loss of penumbra in its trailing region. All other regions remain small or simple, with no significant change observed.
Two CMEs that left the northeast quadrant of the Sun late on the 22nd have been analysed and are thought not to be Earth directed, along with a third CME which left the north earlier in the day. A fourth CME can be seen leaving the northwest in LASCO imagery early on the 23rd. This is unlikely to have an Earth directed component but are awaiting further imagery for confirmation.

Solar Wind / Geomagnetic Activity: The solar wind as measured by DSCOVR at L1 suggests connection to a weak high speed stream, most likely from coronal hole 26. Speeds were slightly elevated between 400 and 470 km/s. Density was average or slightly below average (2-8 ppcc). Total magnetic field strength has been weak between 5 and 8 nT. The north-south component varied weakly throughout (-5 to +7 nT). Phi angle was mainly negative, towards the Sun throughout. Geomagnetic activity has been Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES-16 proton flux was at background levels. GOES-16 high energy (greater than 2MeV) electron flux was mainly at background. 24-hour integrated fluence followed was at background and well below the 1e8 integrated pfu threshold. At 22/2400 UTC 2.57e6 integrated pfu was observed.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate with an ongoing chance of isolated M-class flares, most likely from AR3373.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs currently feature in the forecast. A further high speed stream from coronal hole 27 is forecast to connect with the Earth either late on 23 or during 24 Jul, with speeds around 450-550km/s likely. Mainly Quiet to Unsettled geomagnetic activity is expected, with a chance of Active intervals late on the 23 into the 24 Jul and slight chance of a G1/Minor Storm.

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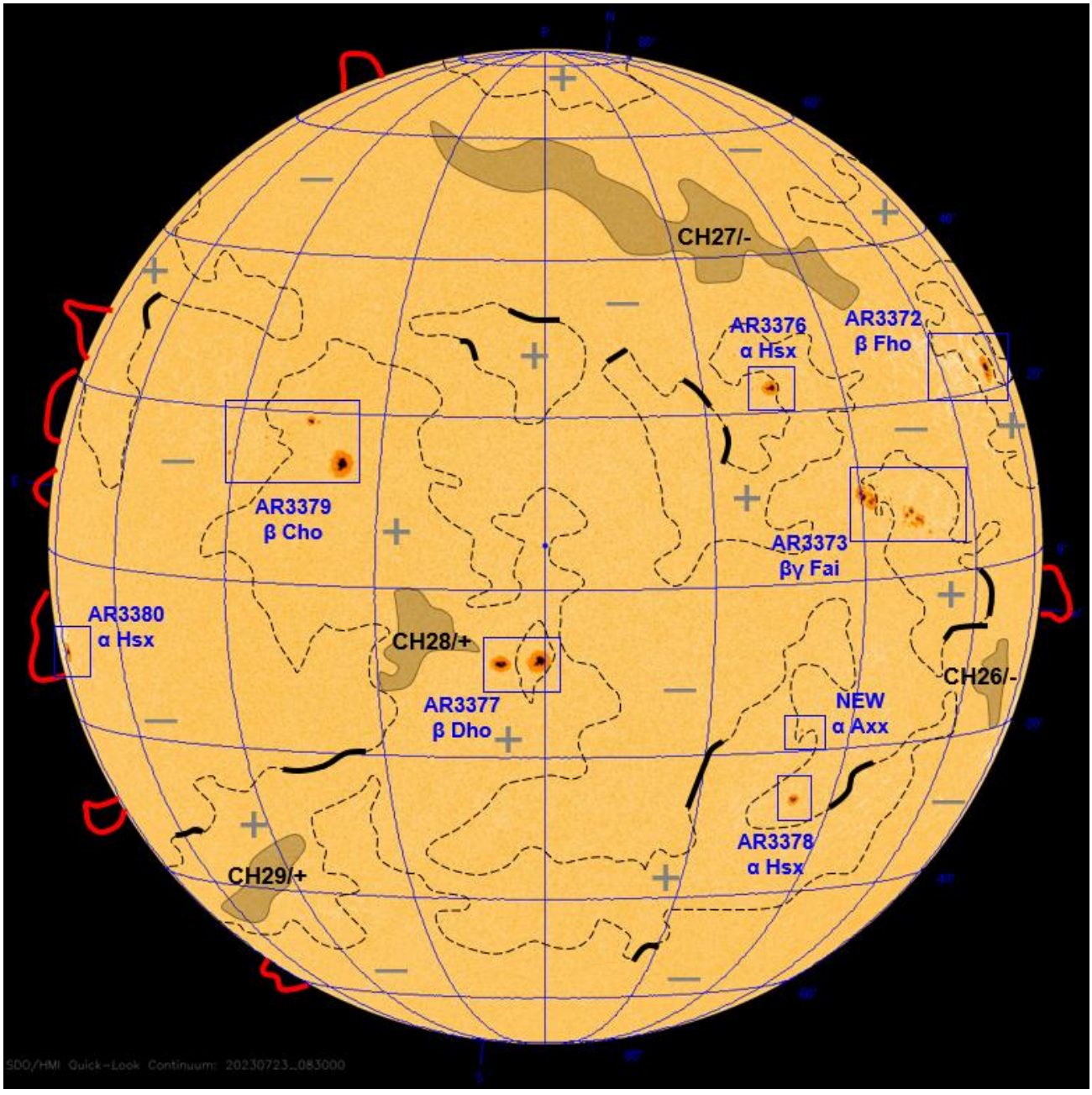
Energetic Particles / Solar Radiation: The high energy (greater than 10MeV) proton flux is expected to persist at background levels, with just a very slight chance of an S1 event. The high energy electron flux (greater than 2MeV) is currently at background levels, with a chance of rising to high at diurnal peaks from day 3 (25 Jul), The associated 24 hour fluence is expected to remain below the active (1e8 total pfu) threshold, but likely rising by the end of the period.

Figure 1. Solar Analysis Valid 23/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

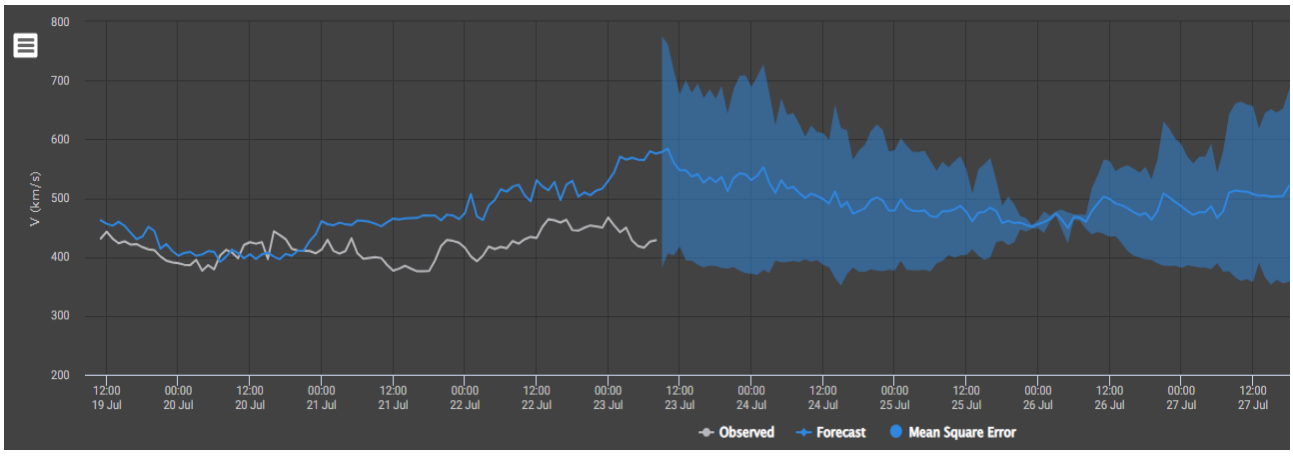
No earth directed CMEs currently feature in the forecast.
Otherwise slightly elevated solar winds may become further enhanced either late on 23 or during 24 Jul, due to connection with a high speed stream from coronal hole 27 in the northern hemisphere. This produced speeds of around 450-550km/s on the last rotation, with a similar enhancement likely on this occasion. Winds are then forecast to ease through day 4 (26 Jul) as these effects wane.
Geomagnetic activity is forecast to be mainly Quiet to Unsettled, with a chance of Active intervals late on the 23 into the 24 Jul due to the high speed stream connection and slight chance of a G1/Minor Storm.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

Figure 2: MOSWOC Solar Wind Persistence Model (SWPM)



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Radio Blackouts - X-Ray Flares:

Solar activity is forecast to be mainly Low to Moderate, with a chance of isolated M-flares. The main risk is from AR3373, which is a relatively large and complex region in the northwest quadrant. This is one of eight regions on the visible disc, with AR3372 and AR3379 also worthy of note, being of similar size, but less complex. All three of the larger regions currently on the disc appear to have shown limited evolution or perhaps decay over the past 24 hours. A new region appearing round the southeast limb, also has the potential to reveal a greater complexity based on analysis of SDO imagery showing magnetic looping, but for now is analysed as Hsx/Alpha. All other regions remain small or simple, with no significant change observed.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES-16, is now at background level after recent enhancements. There remains a chance of further increases in flux, primarily due to the larger regions on the western hemisphere and any associated flare that these may produce, with an ongoing very slight chance of reaching the S1/Minor Radiation Storm threshold.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	10	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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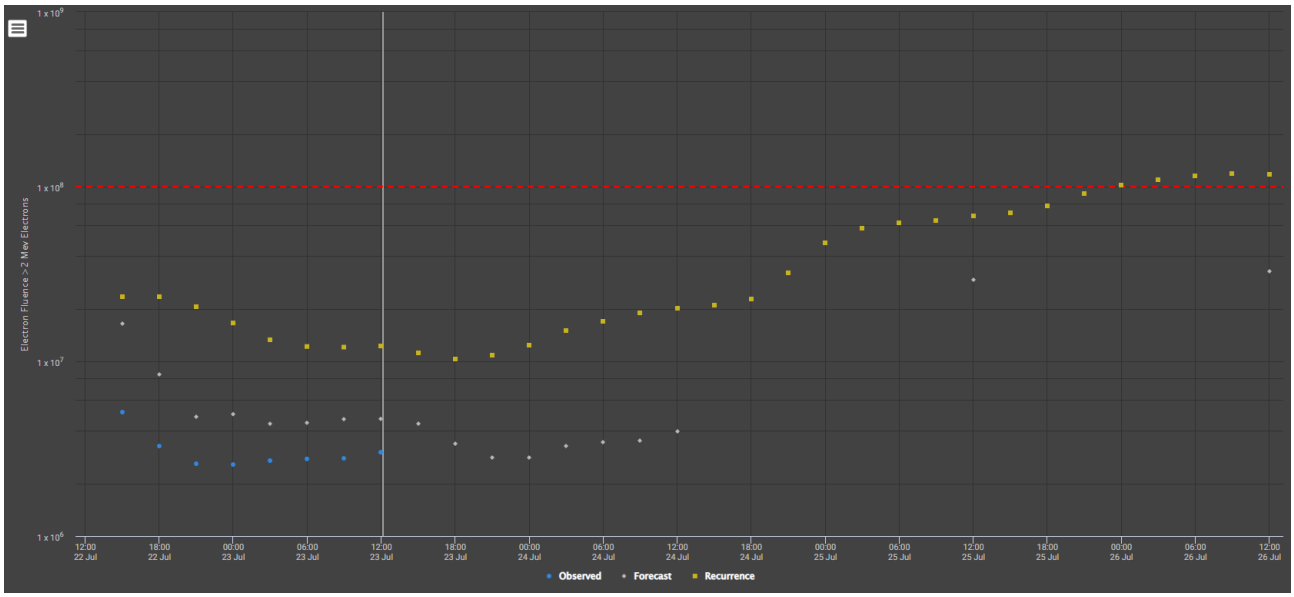
High Energy Electrons Event (≥ 2MeV):

High energy electrons (greater than 2MeV) are at mainly background levels in a generally benign solar wind environment. Recent enhancements and the forecast upcoming high speed stream from CH27 is likely to lead to a rise in flux levels, with a chance of exceeding the high (1e3pfu) threshold from day 3 (25 Jul).
24-hour electron fluence is likely to remain below the Active (1e8 integrated pfu) threshold throughout the period, although a rising trend is expected.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: GOES-16 observed electron fluence, plus REFM and recurrence data.



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